Precision Higgs

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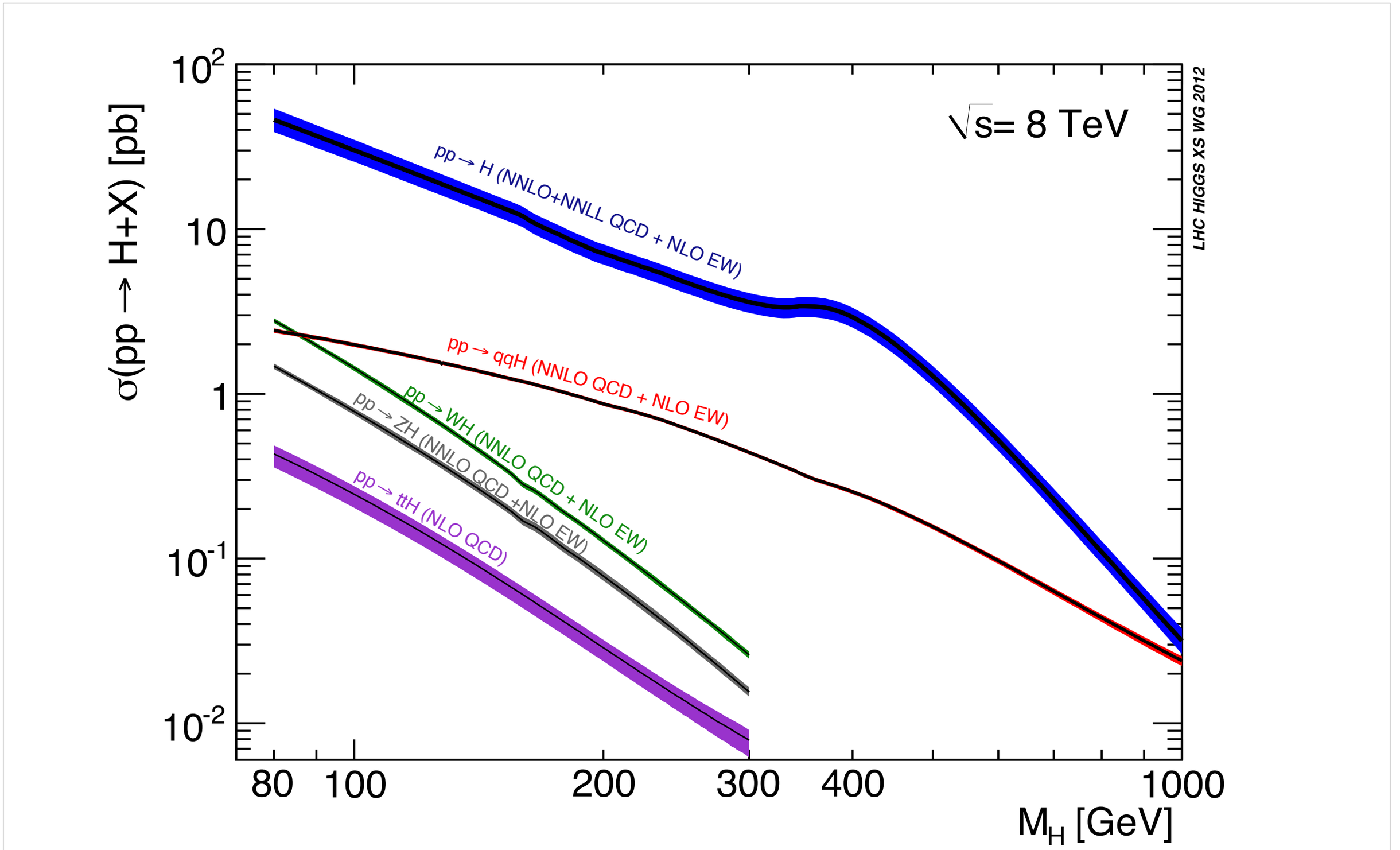
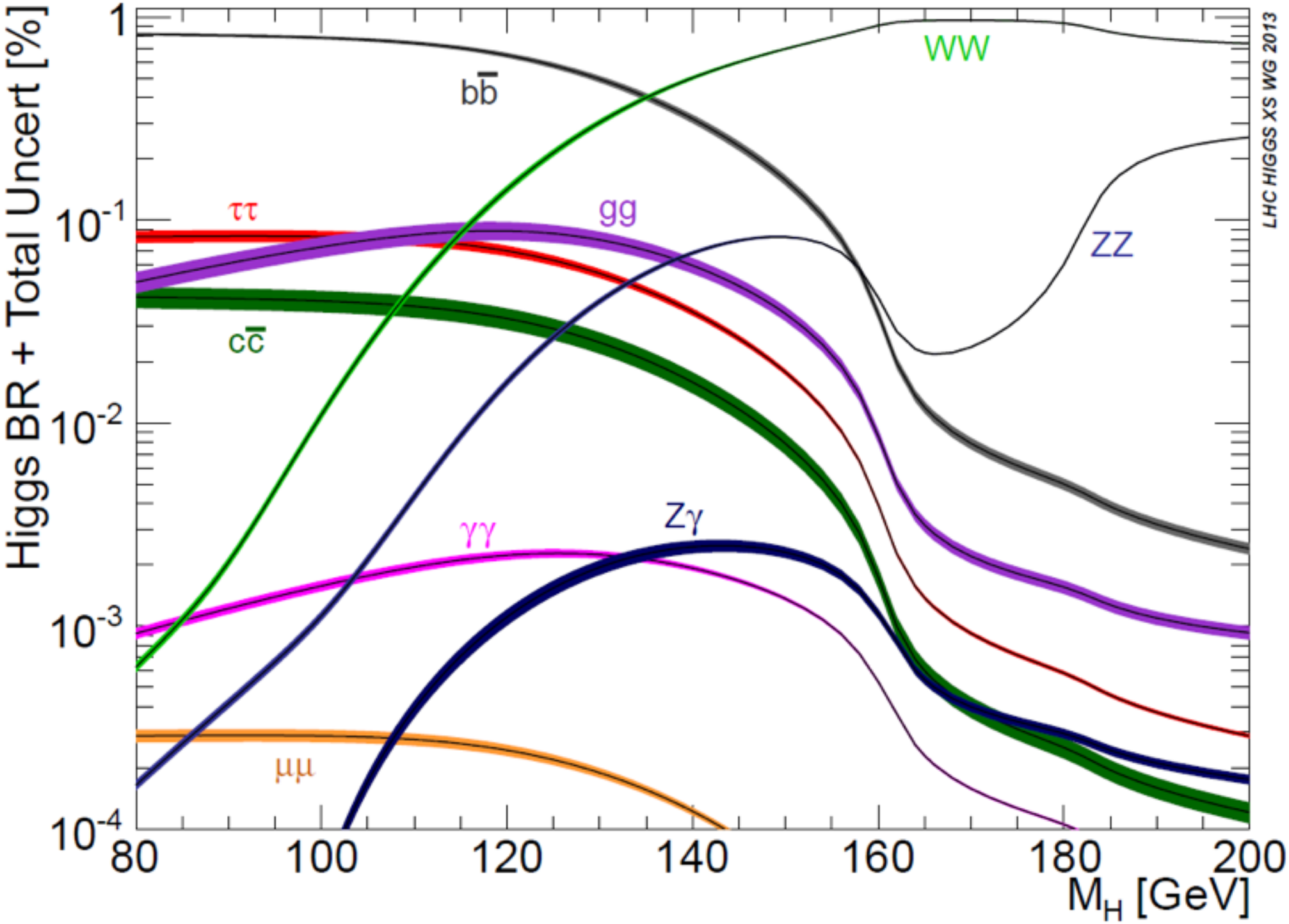
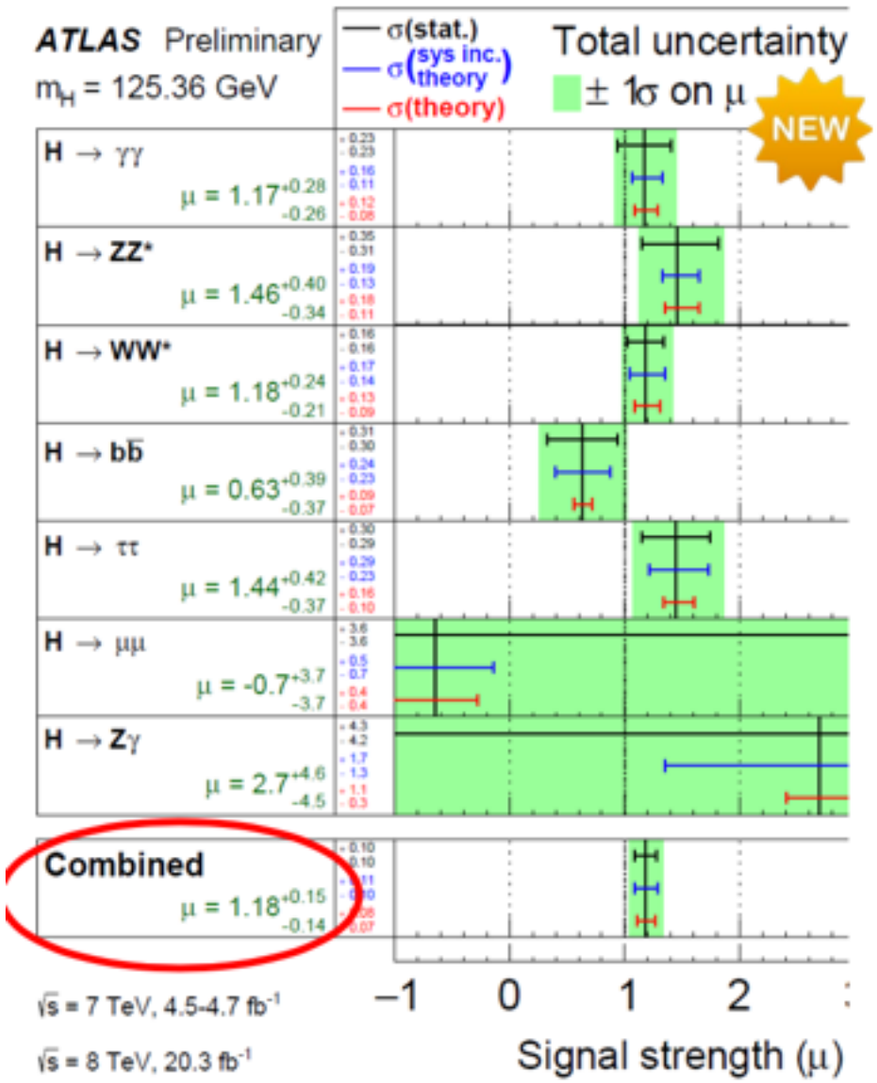
Higgs cross section at the LHC



Higgs cross section at the LHC



Higgs physics at the LHC

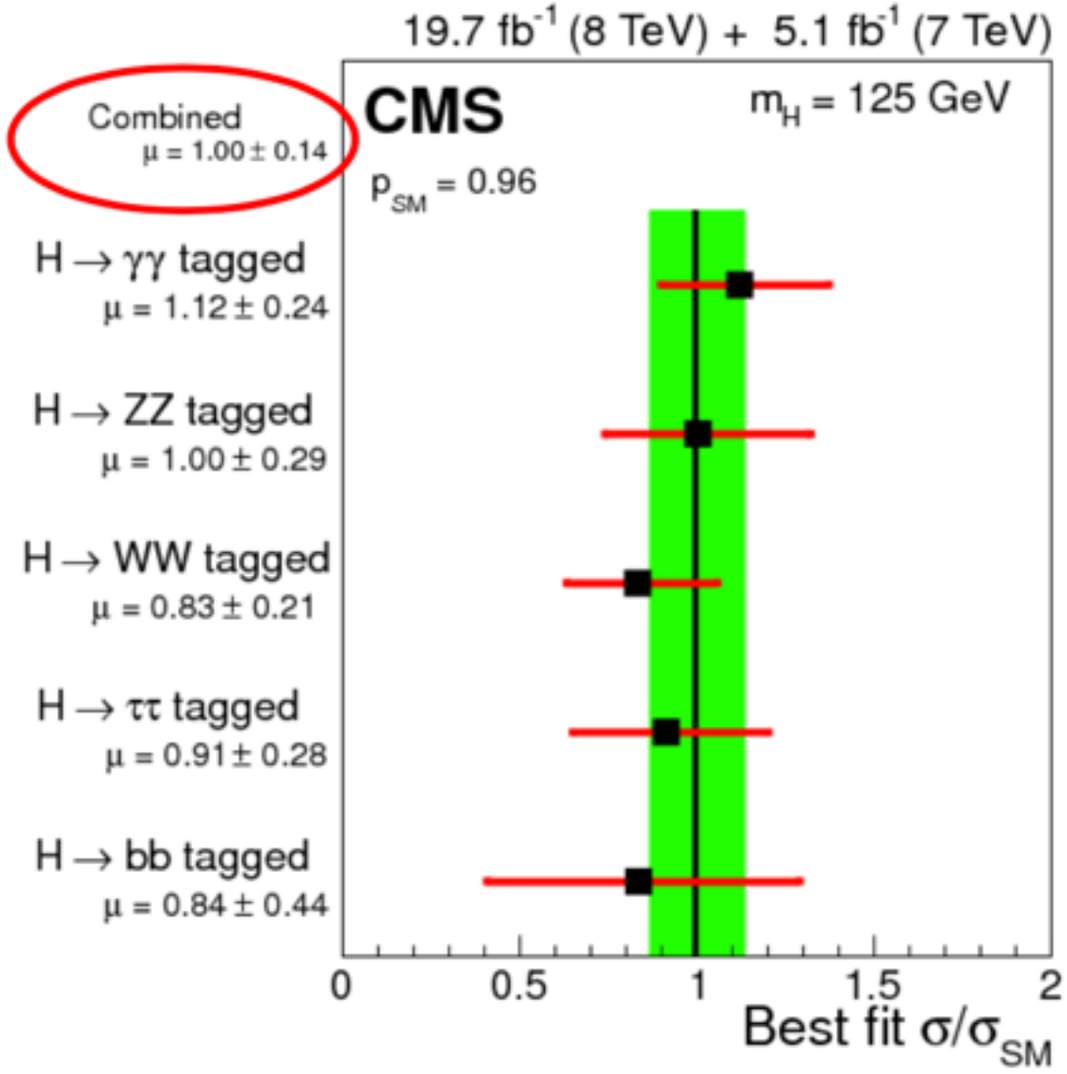


$$\mu_{ATLAS} = 1.18^{+0.15}_{-0.14}$$

$$\text{stat.} = {}^{+0.10}_{-0.10}$$

$$\text{sys. (inc. theo.)} = {}^{+0.11}_{-0.10}$$

$$\text{theory} = {}^{+0.08}_{-0.07}$$

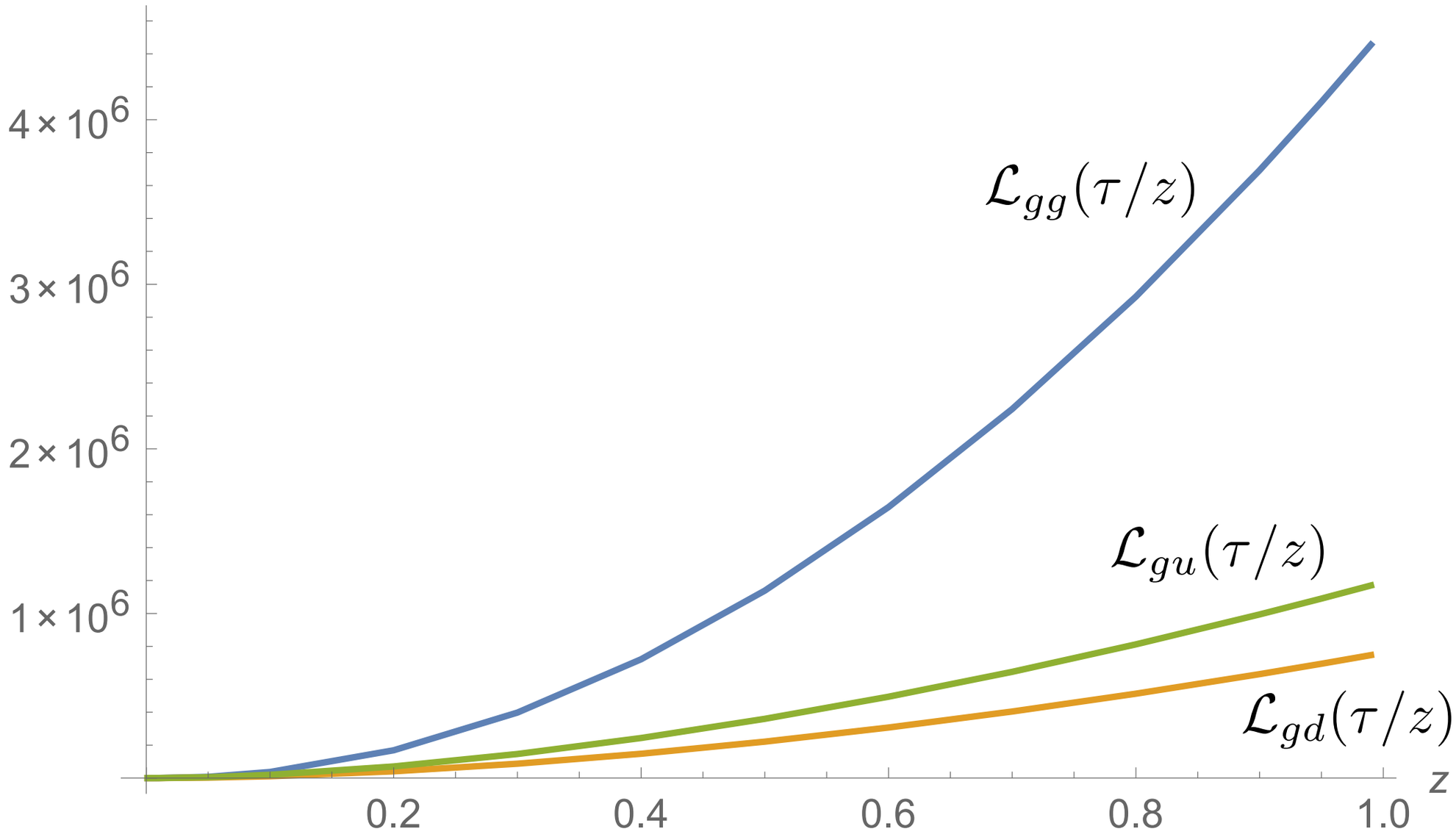


$$\mu_{CMS} = 1.00 \pm 0.14$$

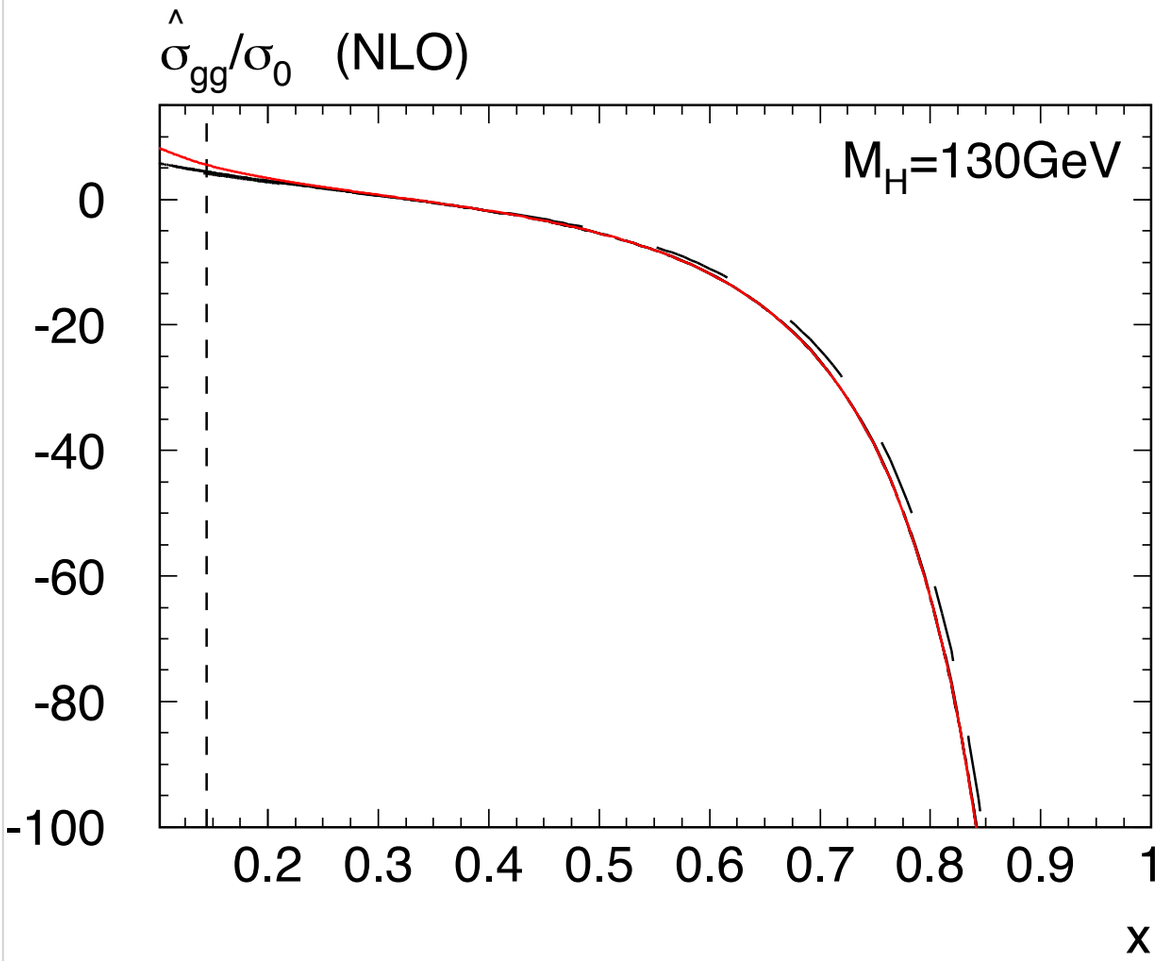
[M. Dührssen @ Moriond EW 2015]

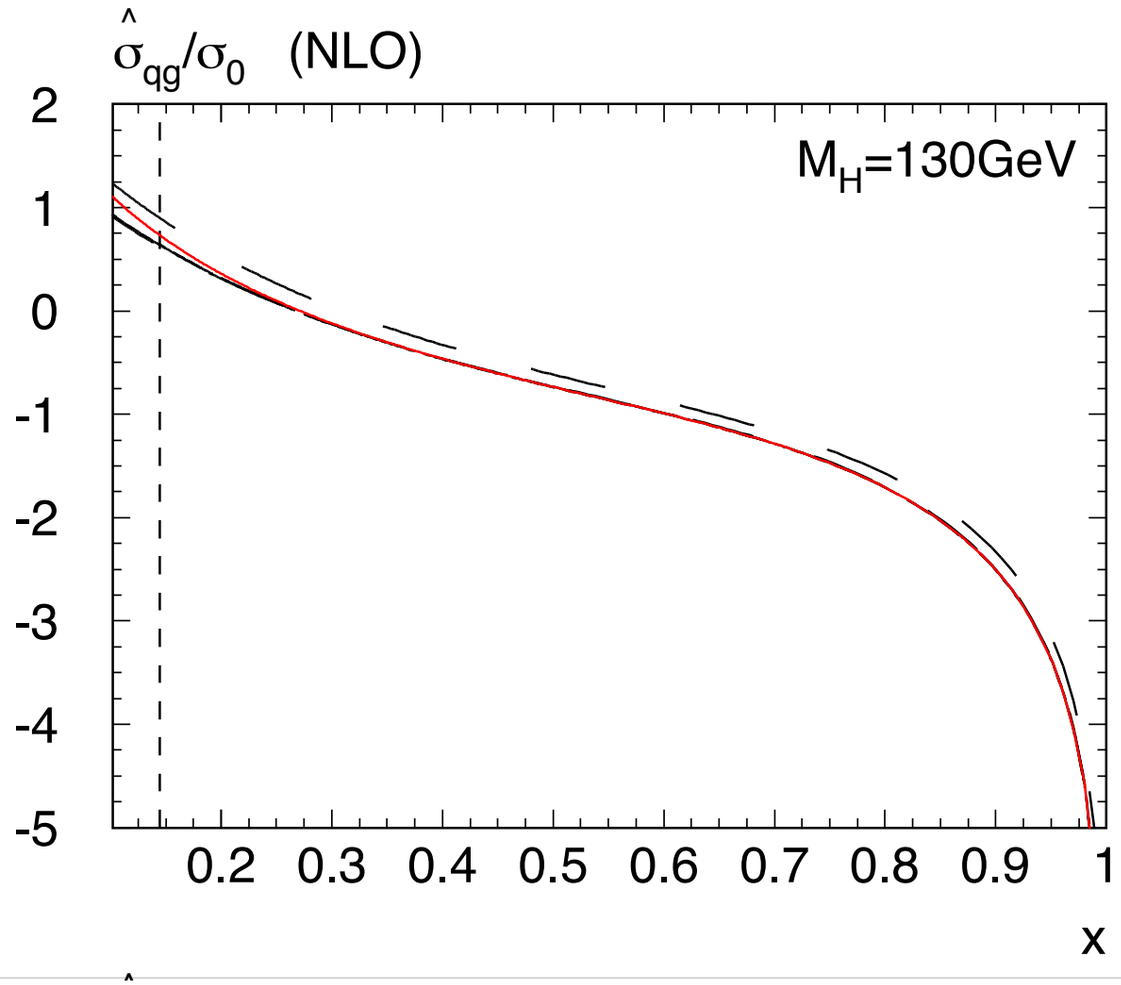
Parton luminosities

$$\sigma = \tau \sum_{ij} \int_\tau^1 \frac{dz}{z}\, \mathcal{L}_{ij}(\tau/z)\, \frac{\hat{\sigma}_{ij}(z)}{z} \qquad z = \frac{m_H^2}{\hat{s}} \qquad \tau = \frac{m_H^2}{S} \simeq 10^{-4}$$

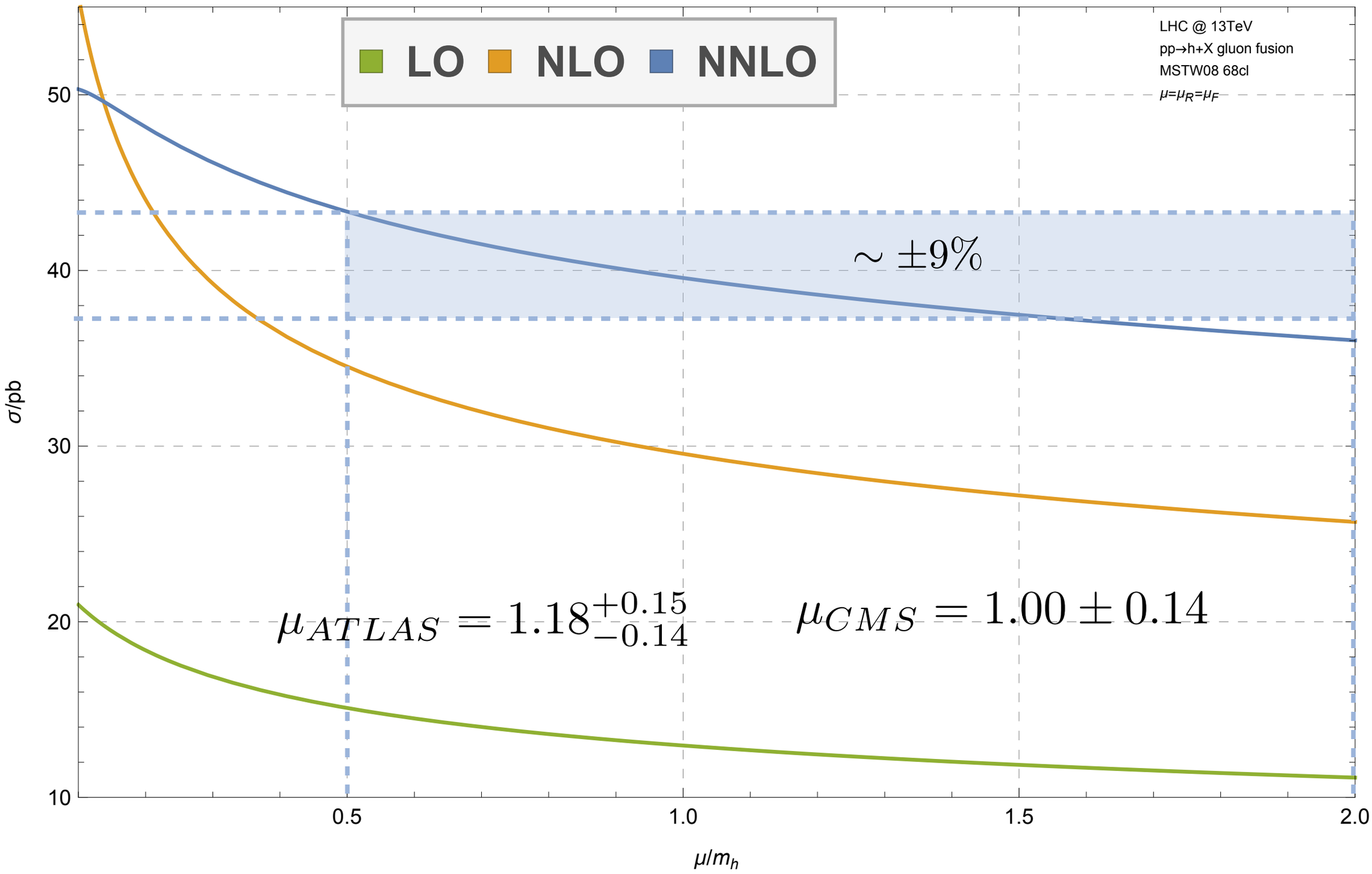


The large mt limit

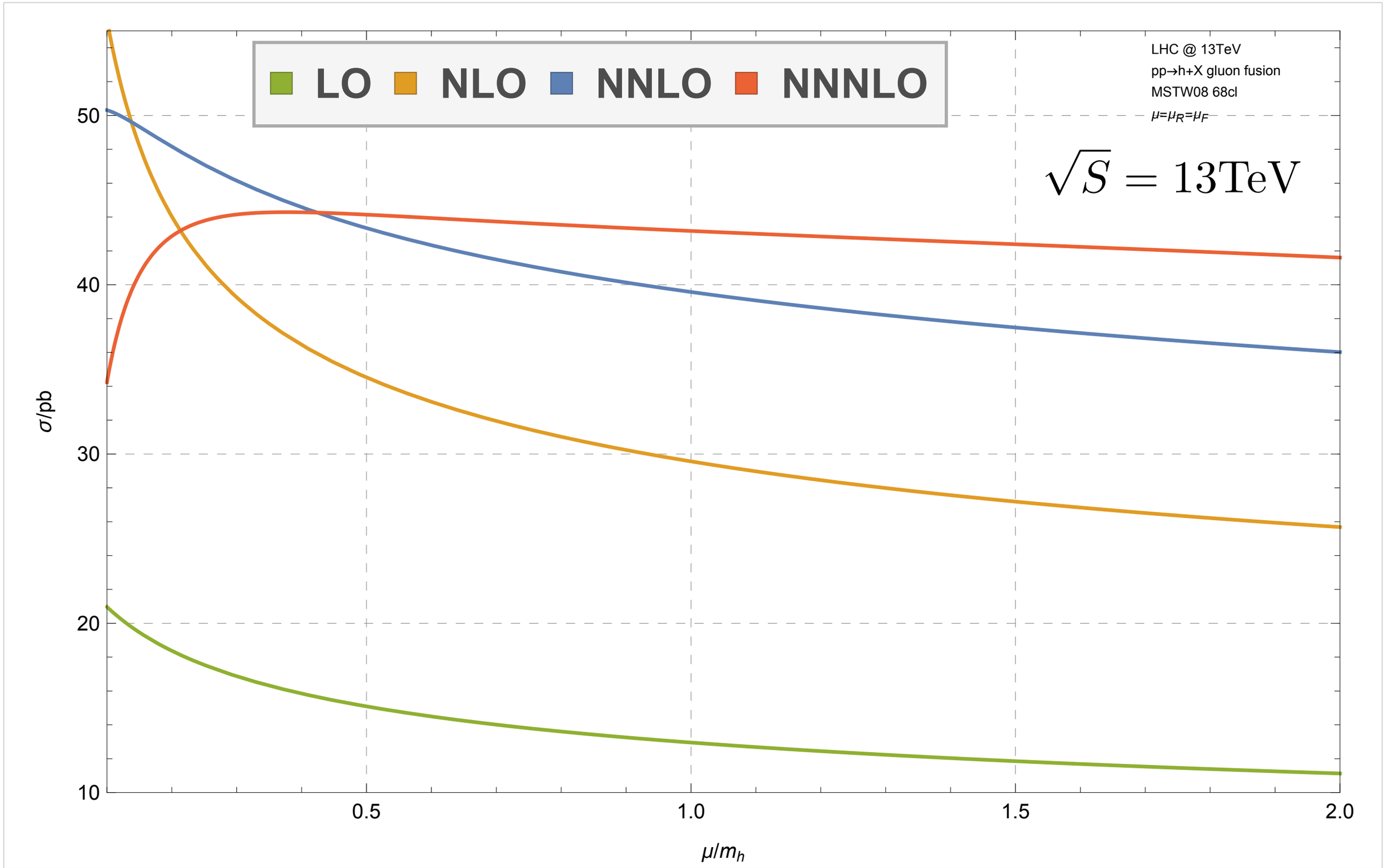




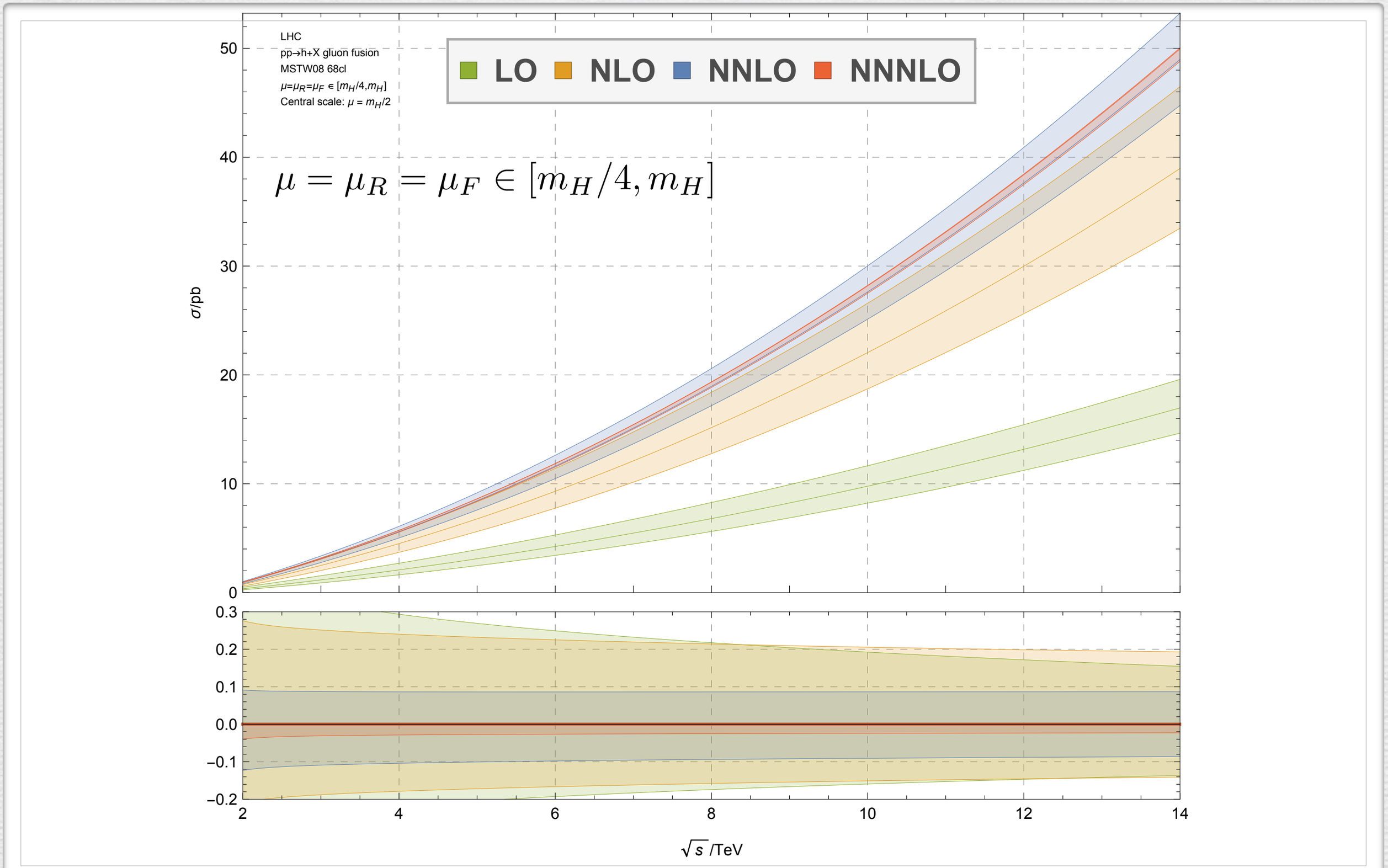
The gluon fusion cross section



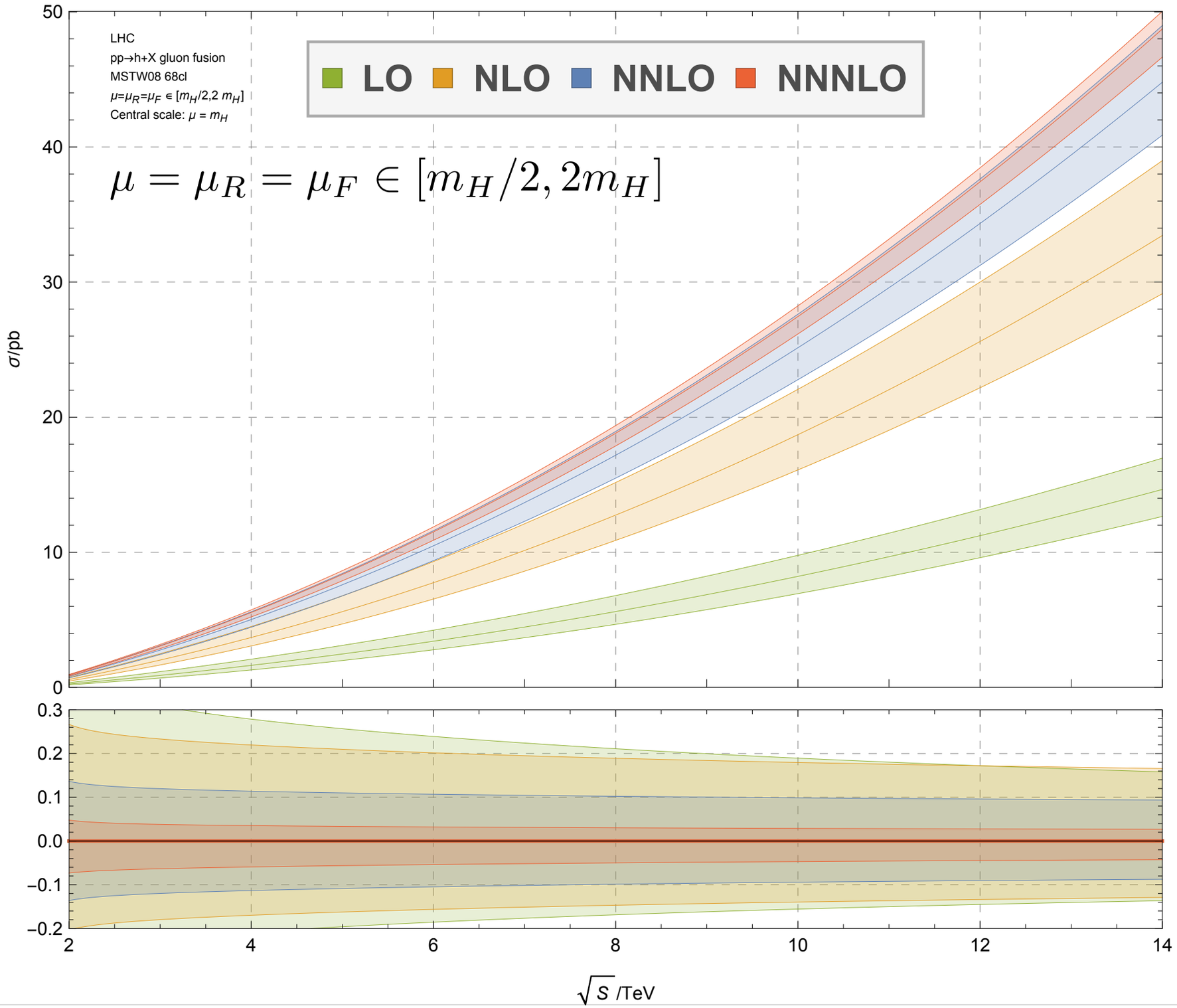
Scale variation



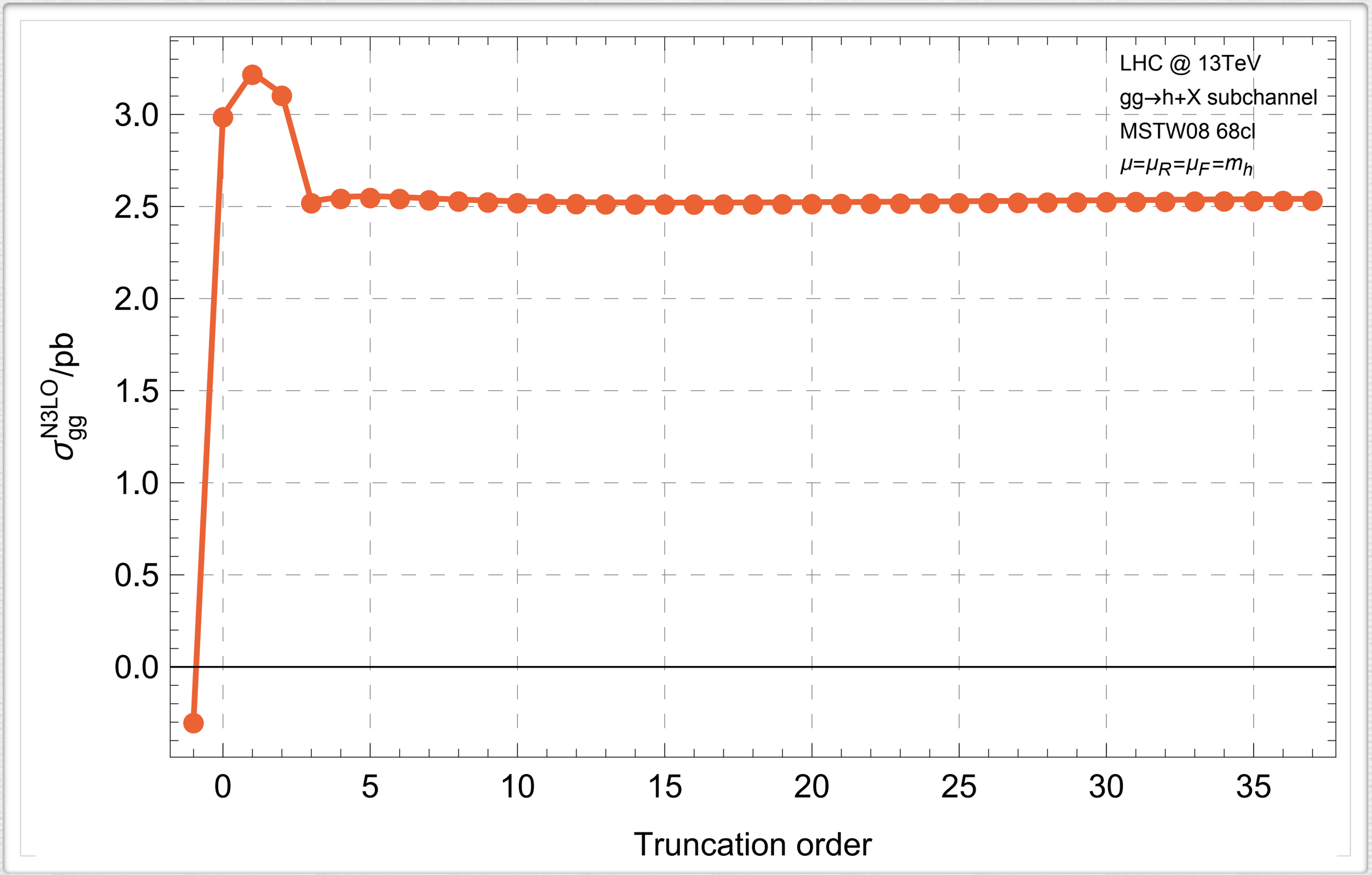
Energy variation



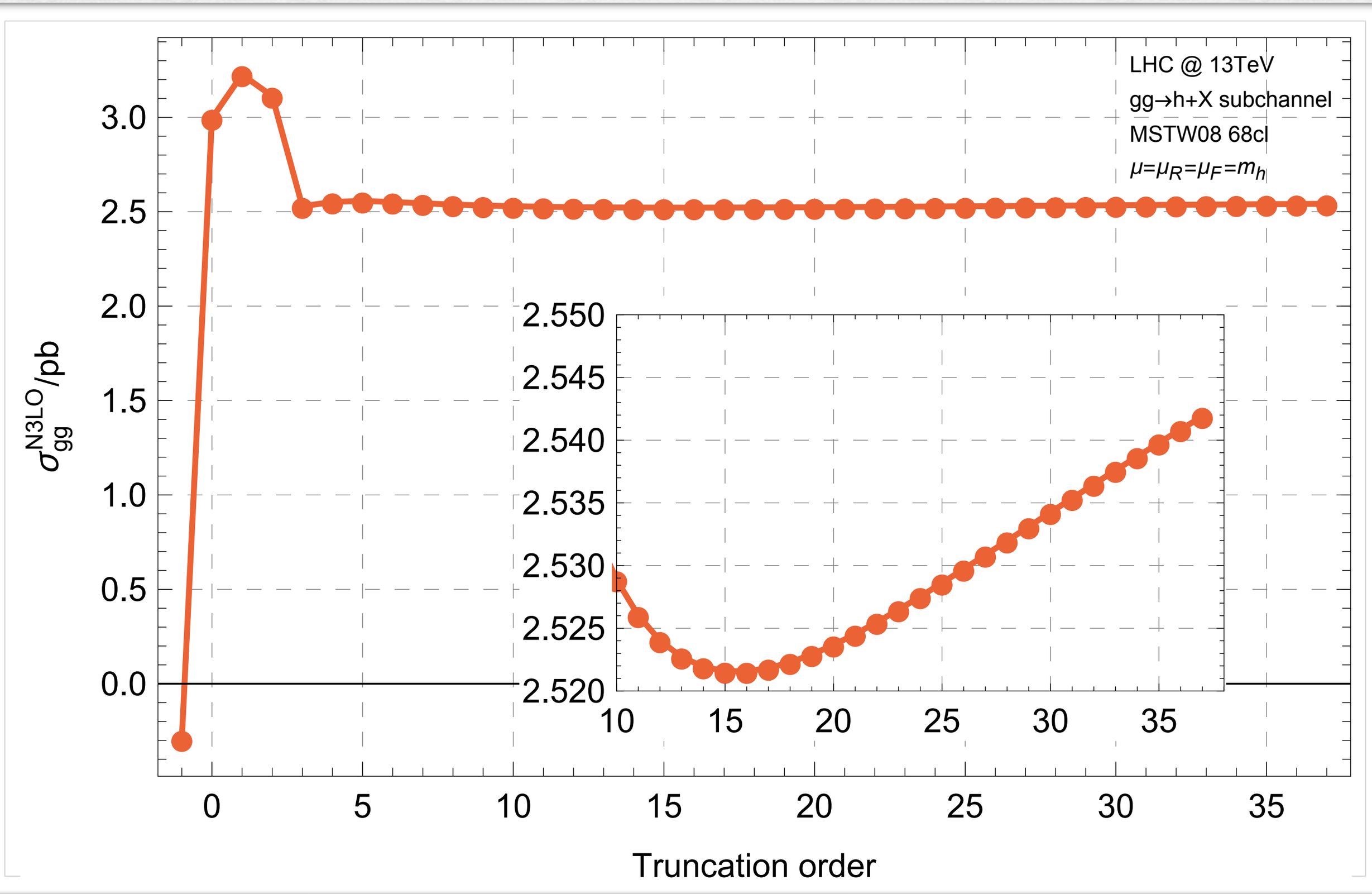
Energy variation



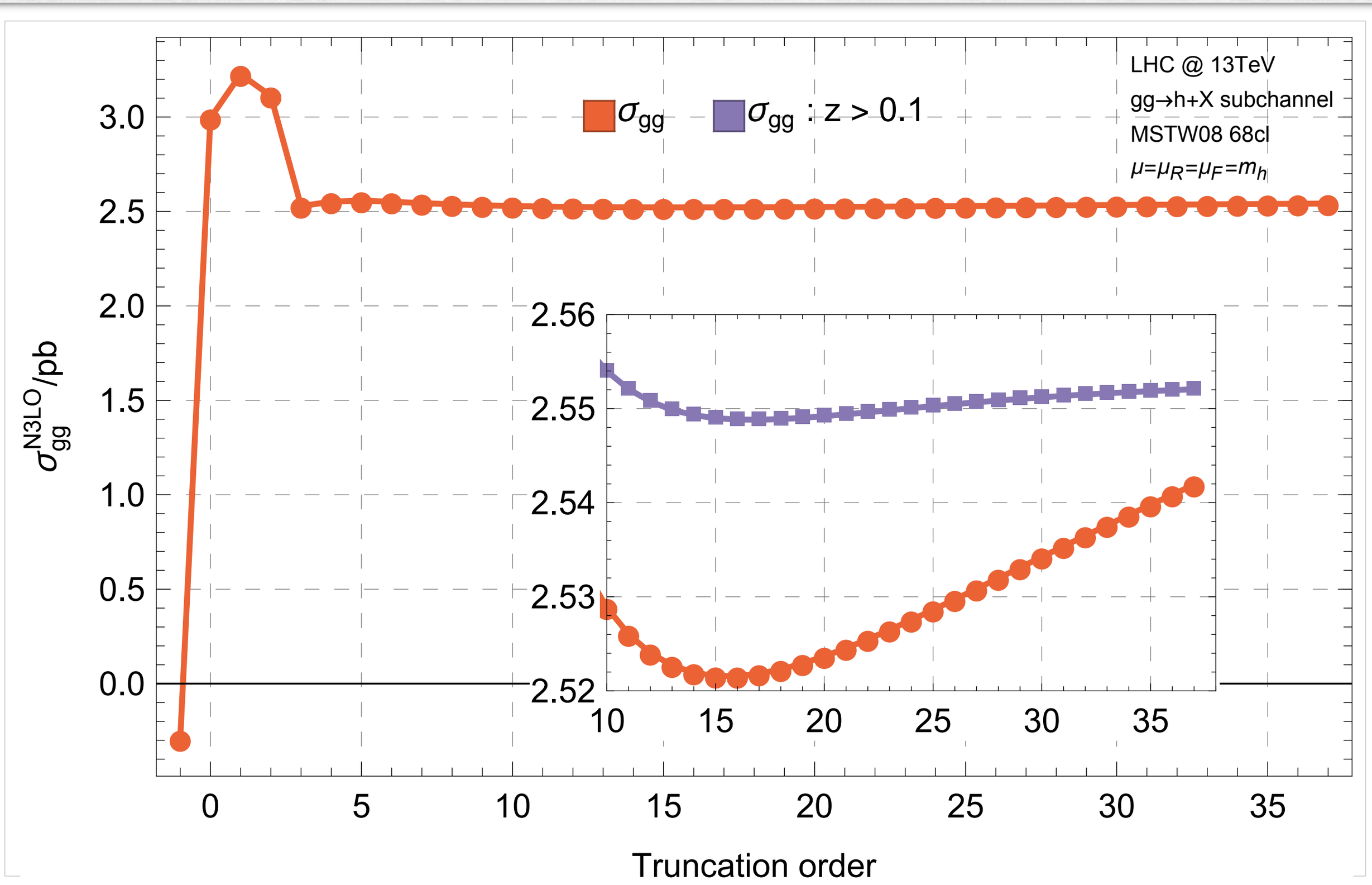
Threshold expansion



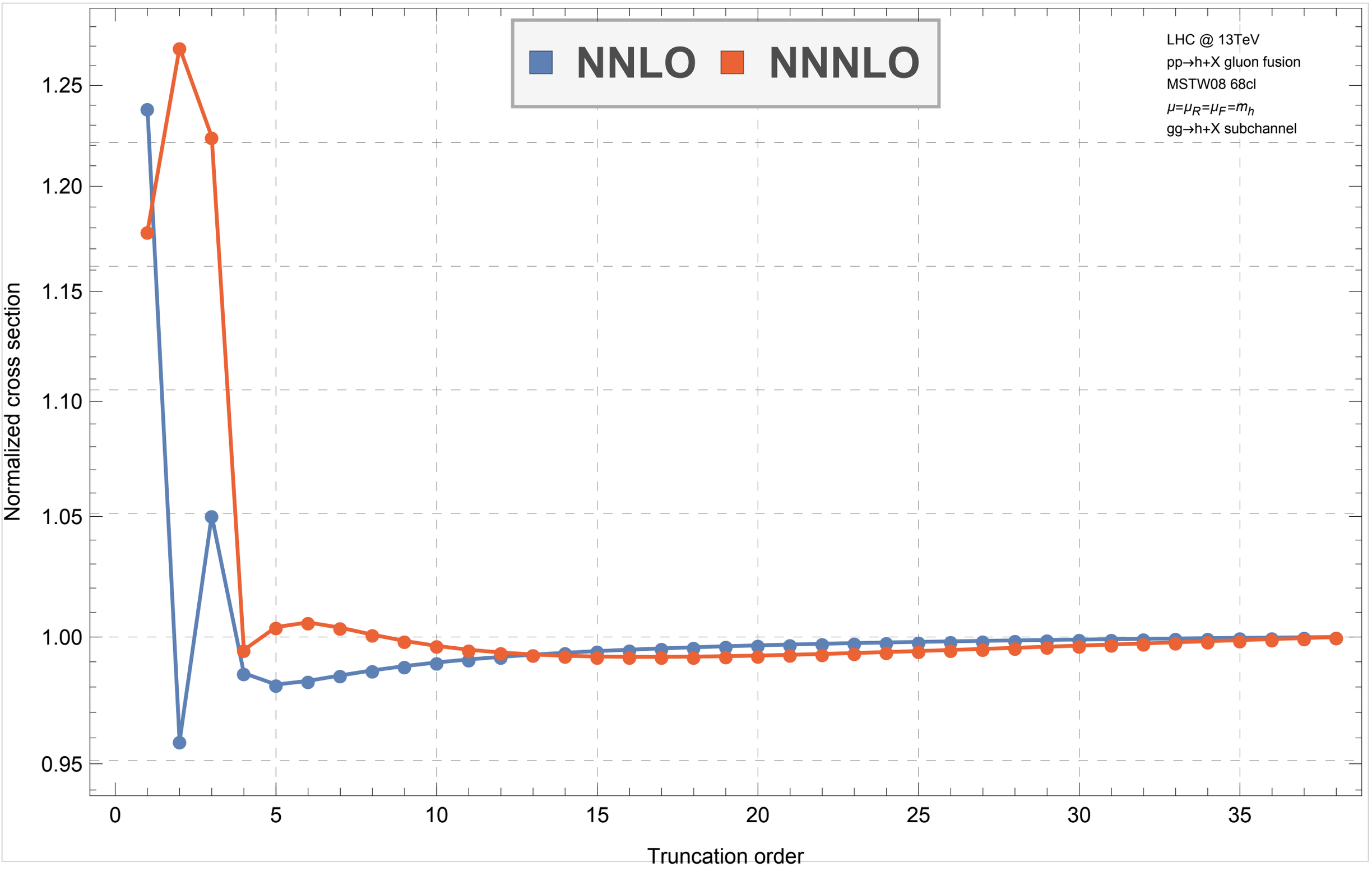
Threshold expansion



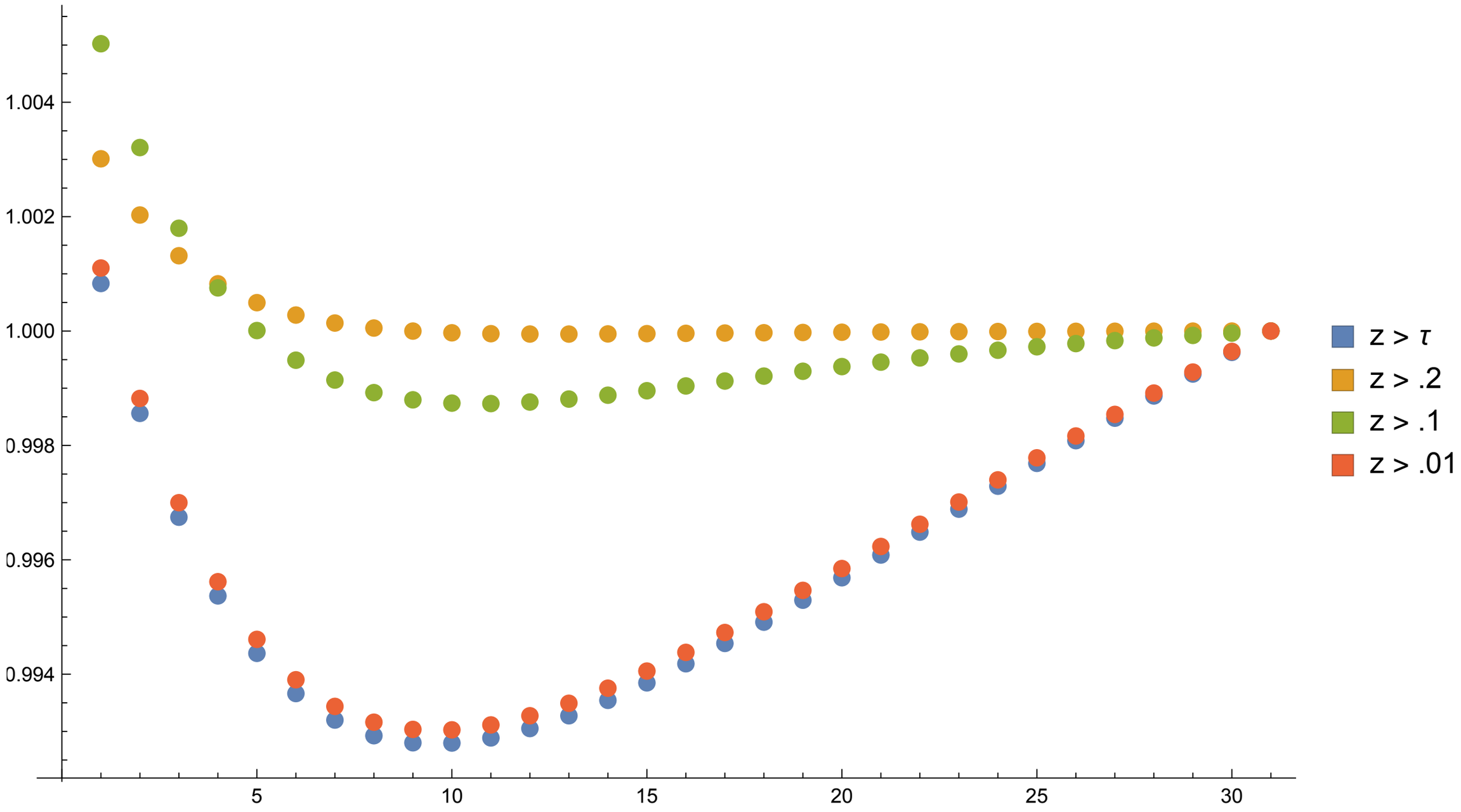
Threshold expansion



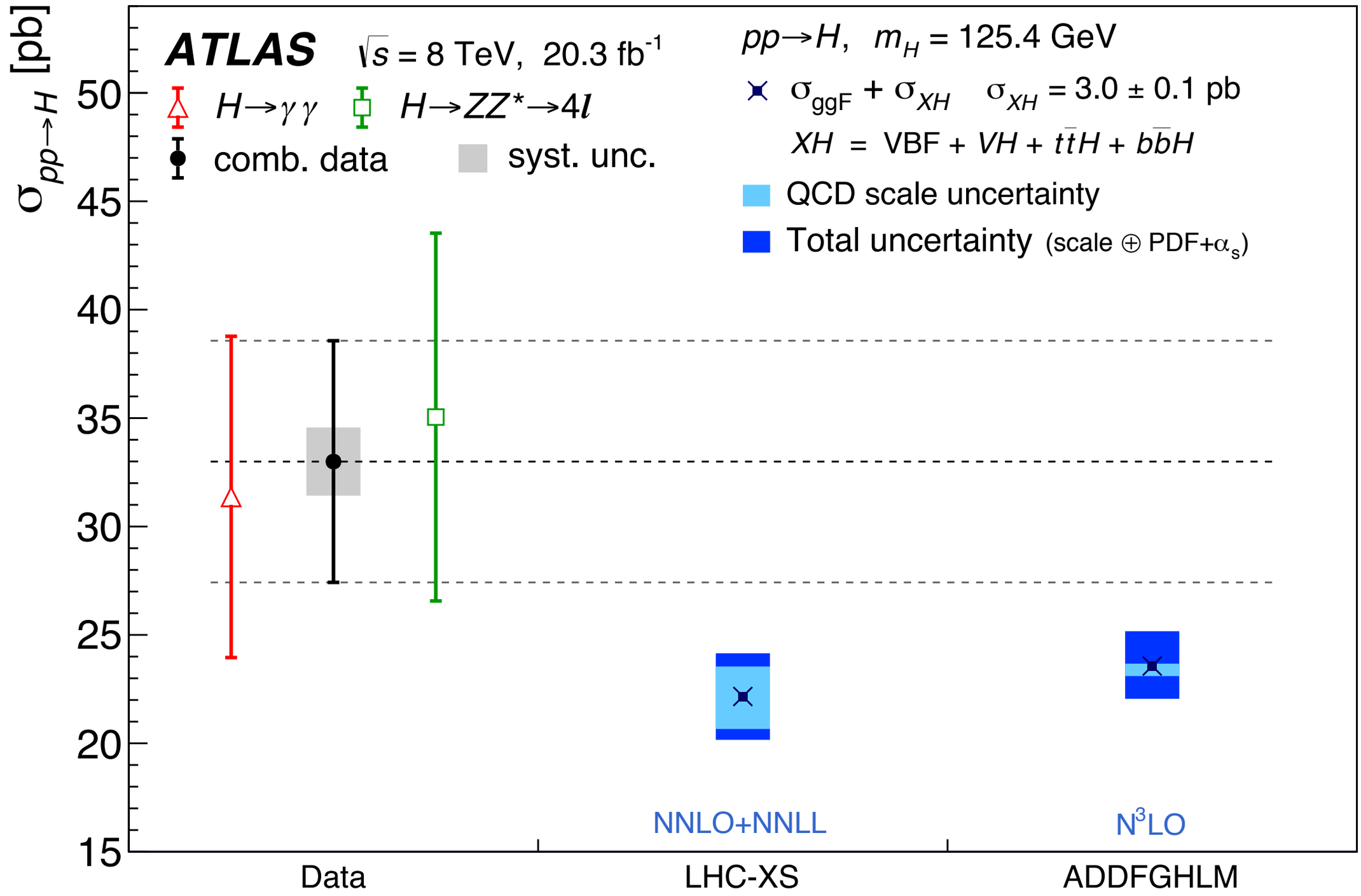
Threshold expansion



Threshold expansion



Scale vs. PDF uncertainty

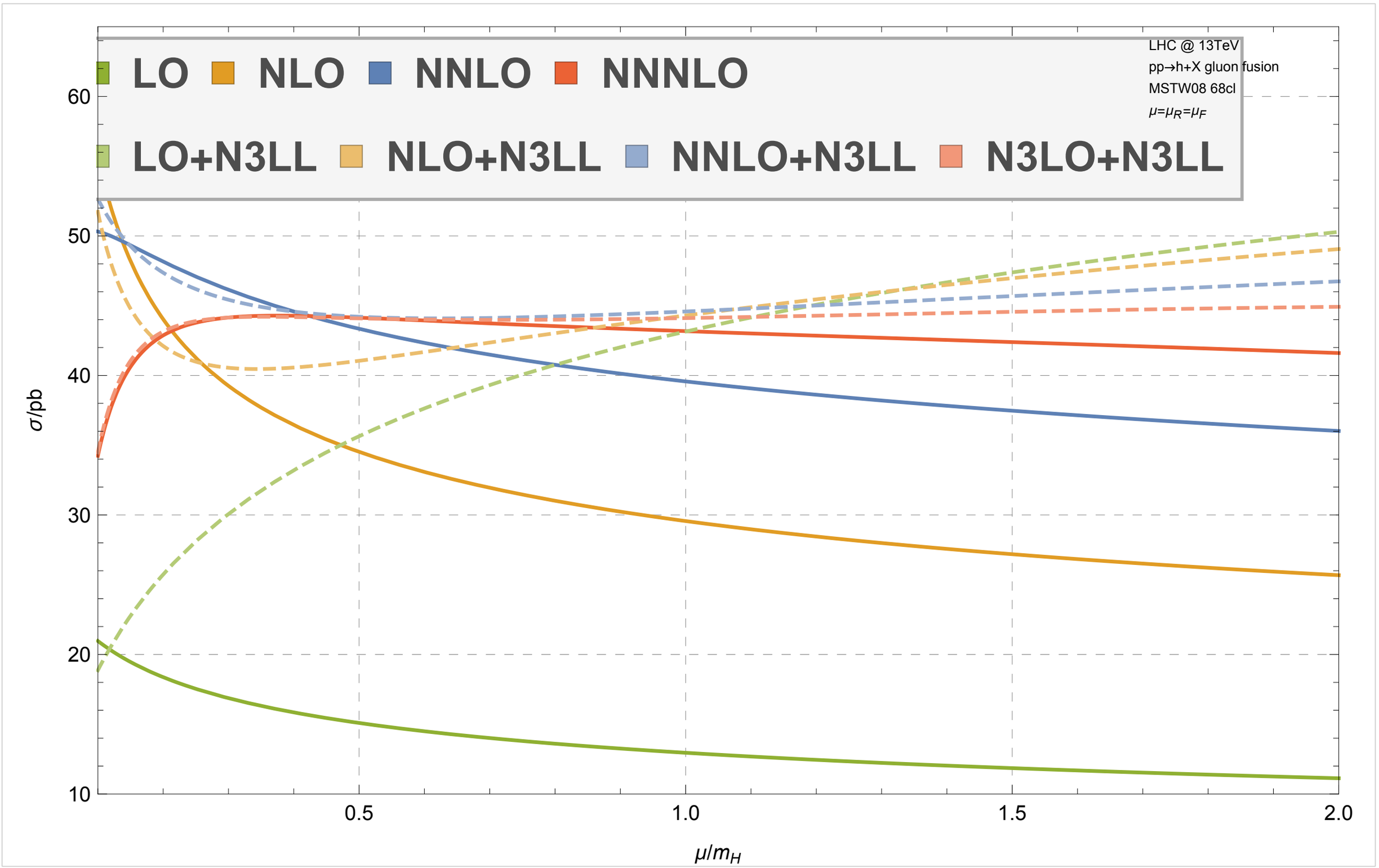


Scale vs. PDF uncertainty

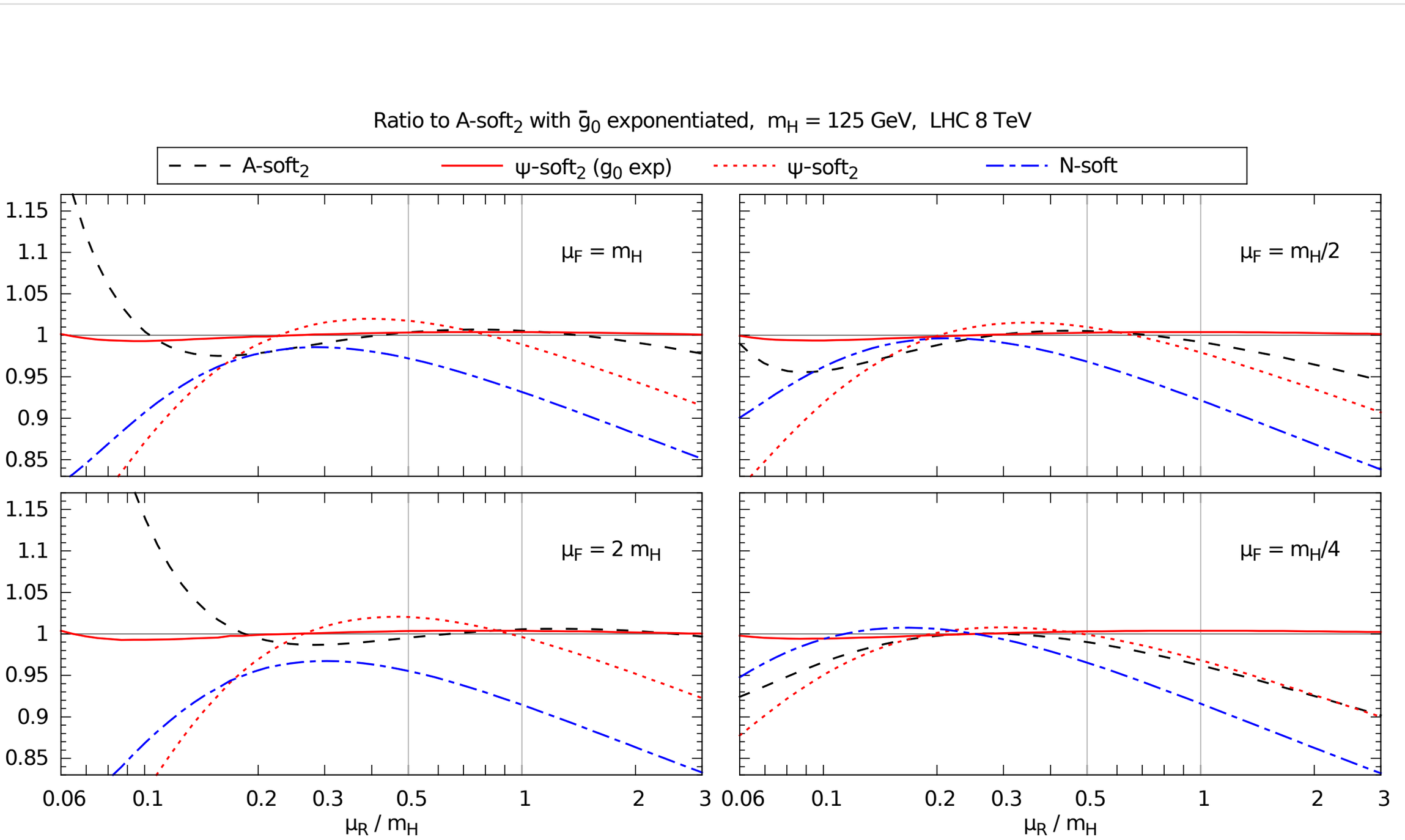
	CT14	MMHT2014	NNPDF3.0	CT10
8 TeV	$18.66^{+2.1\%}_{-2.3\%}$	$18.65^{+1.4\%}_{-1.9\%}$	$18.77^{+1.8\%}_{-1.8\%}$	$18.37^{+1.7\%}_{-2.1\%}$
13 TeV	$42.68^{+2.0\%}_{-2.4\%}$	$42.70^{+1.3\%}_{-1.8\%}$	$42.97^{+1.9\%}_{-1.9\%}$	$42.20^{+1.9\%}_{-2.5\%}$

[CTEQ collaboration

N3LL threshold resummation



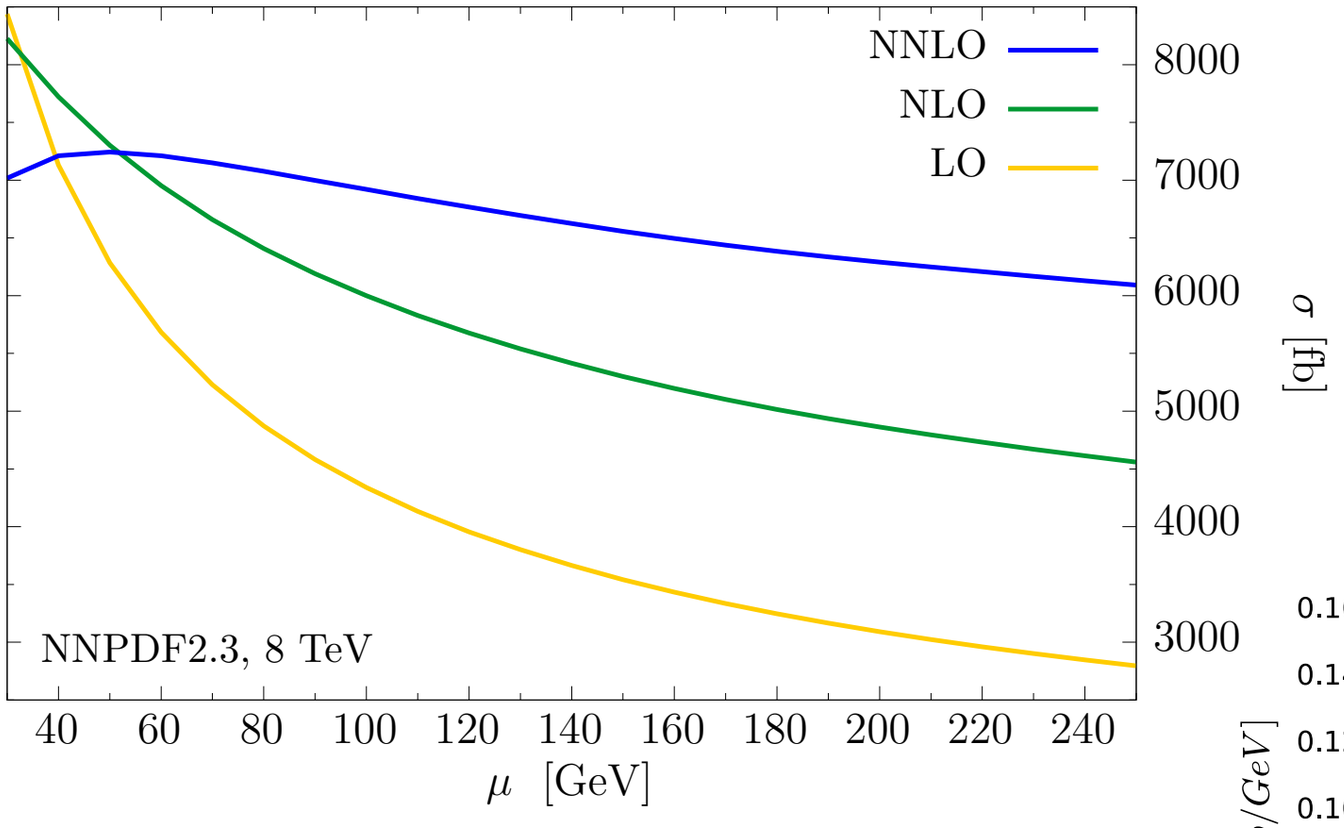
Uncertainties



IR divergences @ NNLO

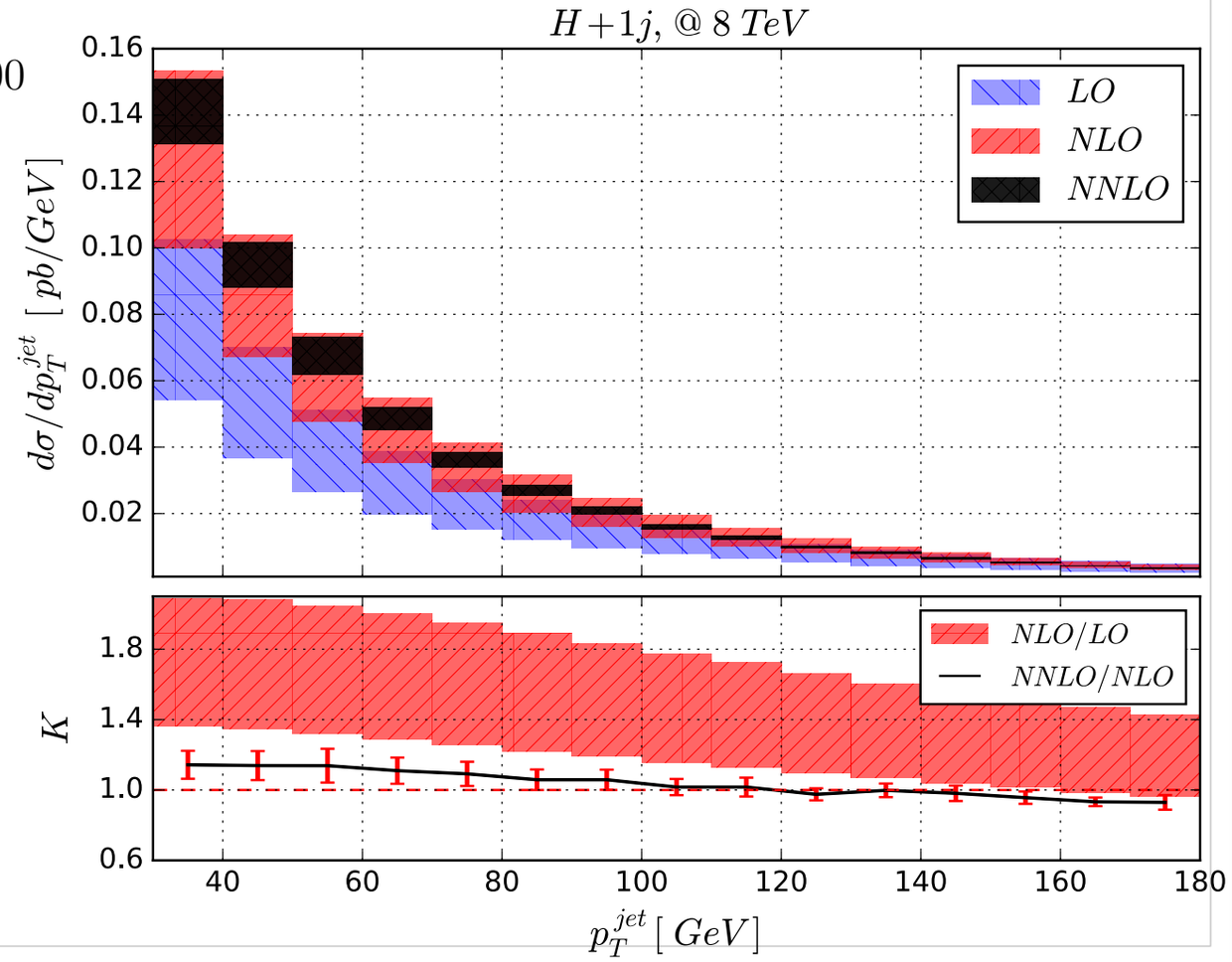
	Analytic	FS Colour	IS Colour	Local
Antenna	✓	✓	✓	✗
qT	✓	✗	✓	✓
Colourful	✓	✓	✗	✓
Stripper	✗	✓	✓	✓
N-jettiness	✓	✓	✓	✓

H+j @ NNLO



[Boughezal, Caola, Melnikov, Petriello, Schulze

[Boughezal, Focke, Giele, Liu, Petriello

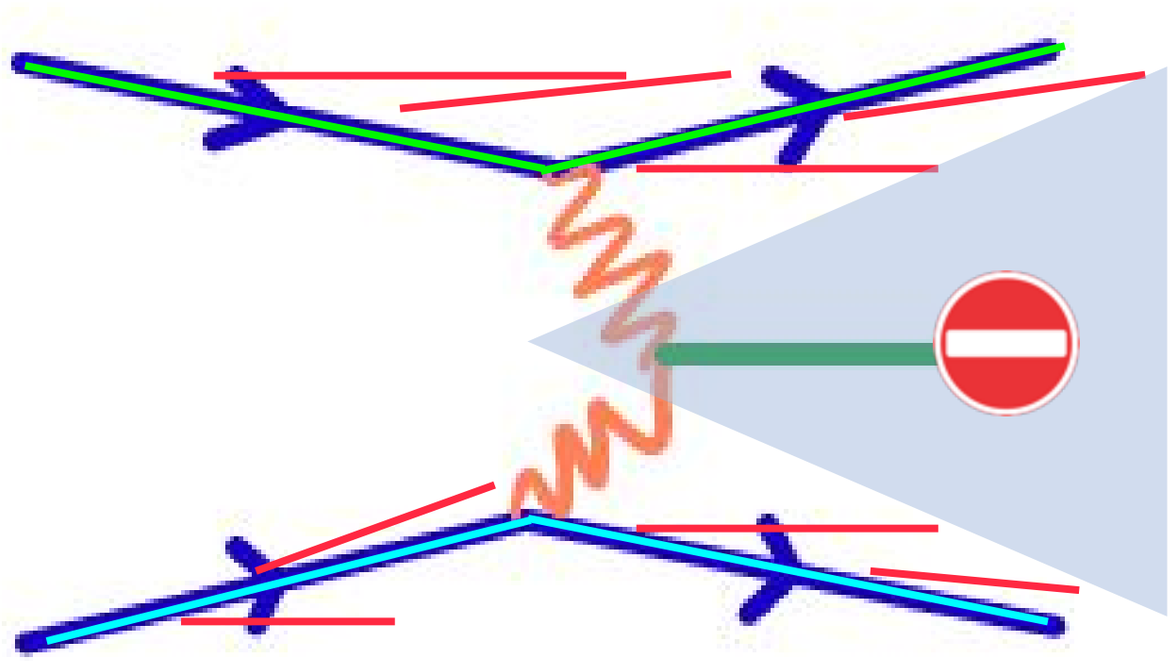


Beyond large mt

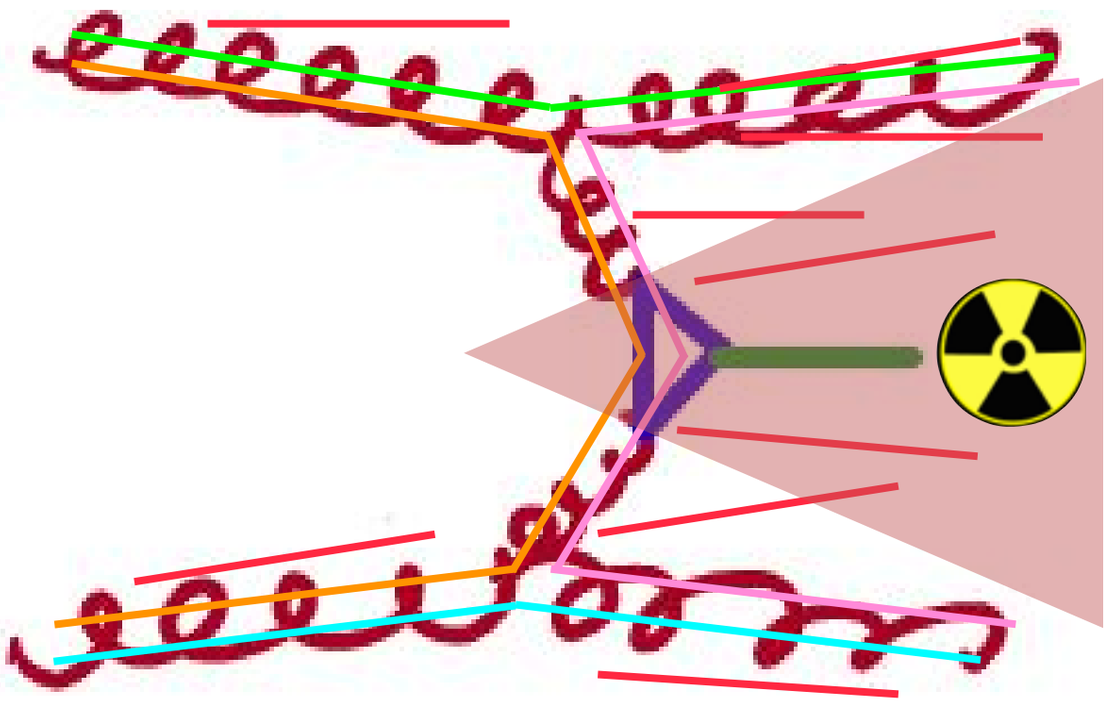
HH production in gluon-gluon fusion at 14 TeV		Cross section [fb]
LO	HEFT	$19.2^{+35.2+2.8\%}_{-24.3-2.9\%}$
	FT, $\Gamma_t = 0$ GeV	$23.2^{+32.3+2.0\%}_{-22.9-2.3\%}$
	FT, $\Gamma_t = 1.5$ GeV	$22.7^{+32.3+2.0\%}_{-22.9-2.3\%}$

[Maltoni, Vryonidou, Zaro

Vector-boson-fusion

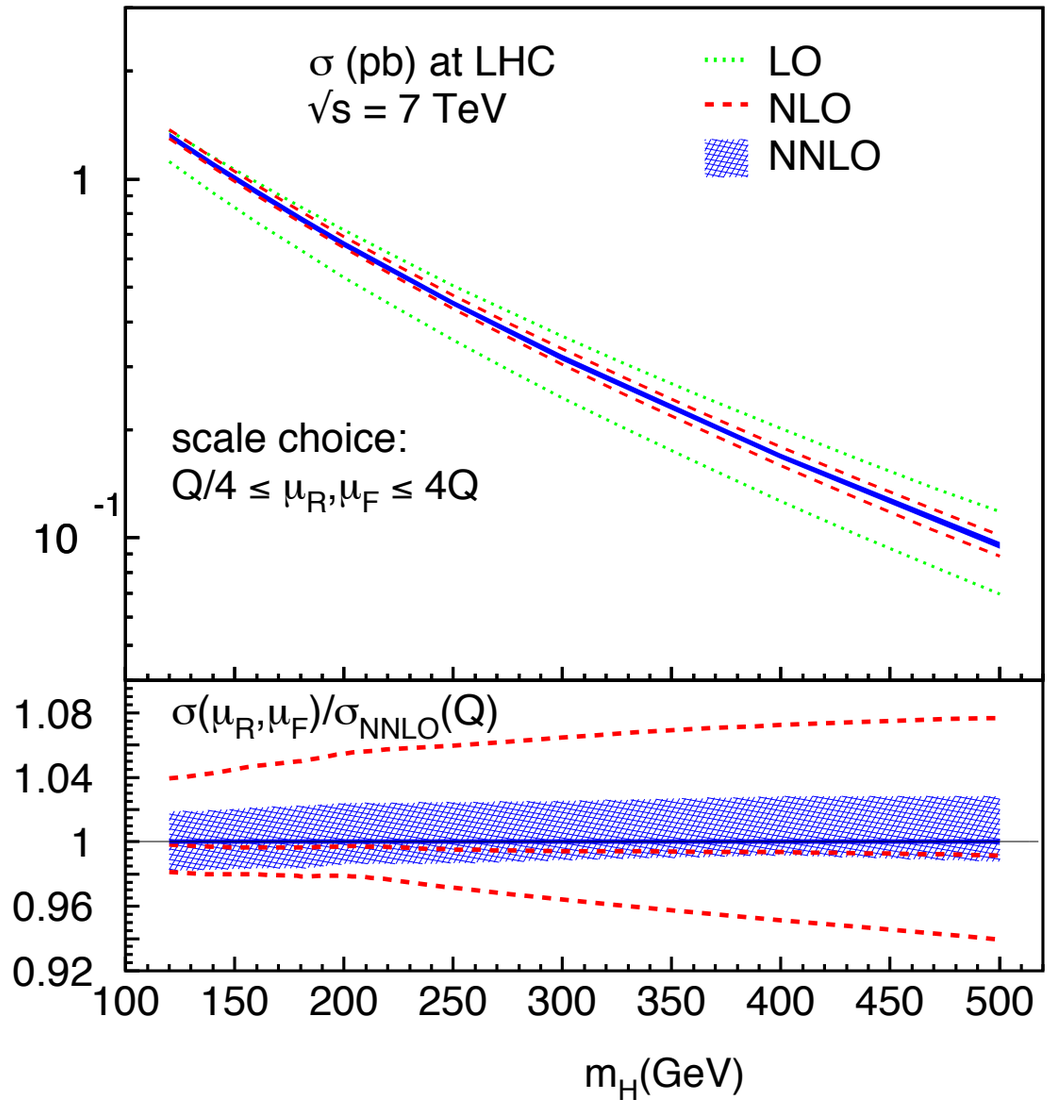


Singlet exchange



Octet exchange

Inclusive cross section



$\sqrt{S} = 7$ TeV			
Higgs mass	LO	NLO	NNLO
120	$1.235^{+0.131}_{-0.116}$	$1.320^{+0.054}_{-0.022}$	$1.324^{+0.025}_{-0.024}$
160	$0.857^{+0.121}_{-0.099}$	$0.915^{+0.046}_{-0.016}$	$0.918^{+0.019}_{-0.015}$
200	$0.614^{+0.106}_{-0.082}$	$0.655^{+0.038}_{-0.012}$	$0.658^{+0.015}_{-0.010}$
300	$0.295^{+0.070}_{-0.049}$	$0.314^{+0.022}_{-0.010}$	$0.316^{+0.008}_{-0.004}$
400	$0.156^{+0.045}_{-0.030}$	$0.166^{+0.013}_{-0.007}$	$0.167^{+0.005}_{-0.001}$

[Bolzoni, Maltoni, Moch, Zaro

- Small remaining Scale uncertainty (~1-2%)!

Differential cross section

- Recently, the differential NNLO cross section in the structure function approach was obtained. [Cacciari, Dreyer, Karlberg, Salam, Zanderighi
  - ➡ Can apply VBF cuts!
  - ➡ Method: Combine inclusive computation with H+3j computation from POWHEG.

	$\sigma^{(\text{no cuts})}$ [pb]	$\sigma^{(\text{VBF cuts})}$ [pb]
LO	$4.032\,^{+0.057}_{-0.069}$	$0.957\,^{+0.066}_{-0.059}$
NLO	$3.929\,^{+0.024}_{-0.023}$	$0.876\,^{+0.008}_{-0.018}$
NNLO	$3.888\,^{+0.016}_{-0.012}$	$0.826\,^{+0.013}_{-0.014}$
	~1%	~5-6%

Differential cross section